Claims

[c1]   An animal carcass grading system for predicting quality and yield comprising:

an image analysis computing system further comprising,

an image input function operable to input an image from an image capturing system;

a first adaptive color classification function operable to analyze the darkest and brightest areas in the image to establish Background and Fat start points and define an area therebetween to establish a Lean start point and operable to classify pixels as Background, Fat and Lean, respectively;

a preliminary outside contour definition function operable to determine a gradient between background and non-background starting from image border coming inward to establish a preliminary outside contour based on the gradient;

a first erode/dilate function operable to perform erosion and dilation of the preliminary outside contour forming a new outside contour;

a center of gravity determining function operable to determine center of gravity of the new outside contour;

an actual Lean color determination function operable to

define a subarea about the center of gravity and calculate average Lean color in the subarea based on Lean classified pixels to determine an actual Lean color to establish an adaptive Lean start point;

a second adaptive color classification function operable to classify areas as Background, Fat and Lean based on the actual Lean color; and

a classification area function operable to calculate total area, total Lean area, total fat area and total unknown area based on second adaptive color classification.

[c2]   An animal carcass grading system as recited in claim 1 where said image analysis computing system further comprises:

a geometrical correction function operable to correct angular distortions due to a viewing angle of the camera;

a shading correction function operable to transform shading in the image to create an image of approximately equal intensity;

a flip if compliment side function operable to flip the image if it is a compliment side image; and

an intensity level correction function operable to scale an intensity level of the image upward if the intensity level is below a predefined level.

[c3]   An animal carcass grading system as recited in claim 1 where said image analysis computing system further

comprises:

a first adaptive ribeye contour function operable to determine a first adaptive ribeye contour by determining a first adaptive gradient between Lean and non-Lean going outward from the center of gravity;

an ellipse function operable to define an ellipse inside the first adaptive ribeye contour and operable to transform all classifications inside the ellipse to only Lean;

a second adaptive ribeye contour function operable to determine a second adaptive ribeye contour by determining a second adaptive gradient between Lean and non-Lean outside ellipse going outward from the center of gravity;

a second erode/dilation function operable to perform erosion and dilation on the second adaptive ribeye contour forming an eroded/dilated second adaptive ribeye contour where the dilation steps are more than erosion steps;

a third adaptive ribeye contour function operable to determine a third adaptive ribeye contour by determining a third adaptive gradient between Lean within the eroded/dilated second adaptive ribeye contour and non-Lean outside going outward from center of gravity;

a corner/edge function operable to eliminate contours having a corner with a smaller than 90°angular bend forming a final ribeye contour;

a Lean/Fat counting function operable to calculate total area, Lean area, Fat area, Unknown area, marbling parameters, color measurements of Lean pixels; and

a fat strip function operable to measure thickness of fat strip orthogonal to the final contour and calculate area of fat strip, and average fat strip thickness.

[c4]   An animal carcass grading method for predicting quality and yield comprising the steps of:

inputting an image of an object from an image capturing camera;

first adaptively color classifying the darkest and the brightest areas of the image and an area therebetween to define Background, Fat and Lean start points, respectively, and classifying pixels as Background, Fat and Lean, respectively;

defining a preliminary outside contour by determining the gradient from background to non-background starting from the border of the image coming inward and establishing the preliminary outside contour and eroding and dilating the preliminary outside contour forming a new outside contour;

determining a center of gravity of said new outside contour;

determining actual Lean color by defining a subarea about the center of gravity and determining the average

Lean color from among the areas classified as Lean inside the subarea and defining the actual Lean color to establish an adaptive Lean start point;

second adaptively color classifying areas as Background, Fat and Lean based on actual Lean color; and

classifying area by calculating total area, total Lean area, and total Fat area.

[c5] The animal carcass grading method for predicting quality and yield as recited in claim 4 further comprising the steps of:

geometrically correcting angular distortions in image due to viewing angle of camera;

correcting shading in image by transforming image to an image of approximately equal intensity;

flipping the image if it is a compliment side image; and

scaling intensity level of image upward if intensity level is below a predefined level.

[c6] The animal carcass grading method as recited in claim 4 further comprising the steps of:

determining a first adaptive ribeye contour by determining a first adaptive gradient between Lean and non-Lean going outward from the center of gravity;

defining an ellipse inside the first adaptive ribeye contour and transforming all classifications inside the ellipse to only Lean;

determining a second adaptive ribeye contour by determining second adaptive gradient between Lean and non-Lean going outward from center of gravity;

forming an eroded/dilated second adaptive ribeye contour by performing erosion and dilation on the second adaptive ribeye contour where dilation steps are more than erosion steps;

determining a third adaptive ribeye contour by determining a third adaptive gradient between Lean within eroded/dilated second adaptive contour and non-Lean going outward from center of gravity;

forming a final contour by eliminating corners/edges having a contour with a smaller than 90°angular bend;

calculating total area, Lean area, Fat area, Unknown area, marbling parameters, and color measurements of Lean pixels and measuring thickness of fat strip orthogonal to final contour and calculating area of fat strip and average fat thickness.

[c7]   An animal carcass grading system for predicting quality and yield comprising:

a computer usable medium having computer readable code thereon, said code executable by a computer to perform image analysis for carcass grading, said computer readable code comprising;

computer readable code functions operable to cause the

computer to effect the receiving of an image from an image capturing system;

computer readable code functions operable to cause the computer to effect first adaptive color classification of the darkest and brightest areas of the image and an area therebetween to define Background, Fat and Lean start points, respectively, and to classify pixels as Background, Fat and Lean, respectively;

computer readable code functions operable to cause the computer to effect the defining of a preliminary outside contour by starting from the border of the image coming inward and determining a gradient from background to non-background;

computer readable code functions operable to cause the computer to effect erosion and dilation of the preliminary outside contour forming a new outside contour;

computer readable code functions operable to cause the computer to effect determining a center of gravity of said new outside contour;

computer readable code functions operable to cause the computer to effect defining a subarea about said center of gravity and determining average Lean color from among areas classified as Lean inside the subarea to establish an adaptive Lean start point;

computer readable code functions operable to cause the computer to effect second adaptive color classification to

Background, Fat, and Lean based upon average Lean color; and

computer readable code functions operable to cause the computer to effect calculating total area, total Lean area, and total fat area.

[c8] The animal carcass grading as recited in claim 7 where said computer readable code further comprises:

computer readable code functions operable to cause the computer to effect geometrical correction of angular distortions of the image due to the viewing angle of the image capturing system;

computer readable code functions operable to cause the computer to effect shading correction by transforming shading in the image to create an image of approximately equal intensity;

computer readable code functions operable to cause the computer to effect flipping the image if it is a compliment sided image; and

computer readable code functions operable to cause the computer to effect scaling of the intensity level of the intensity level of the image upward if the intensity level is below a predefined level.

[c9] The animal carcass grading as recited in claim 7 where said computer readable code further comprises:

computer readable code functions operable to cause the

computer to effect determination of a first adaptive rib-
eye contour by determination of a first adaptive gradient
between Lean and non-Lean going outward from the
center of gravity;

computer readable code functions operable to cause the
computer to effect defining of an ellipse inside the first
adaptive ribeye contour and transformation of all classi-
fications inside ellipse to only Lean;

computer readable code functions operable to cause the
computer to effect determination of a second adaptive
ribeye contour by determination of a second adaptive
gradient between Lean and non-Lean going outward
from the center of gravity;

computer readable code functions operable to cause the
computer to effect a second erosion and dilation on the
second adaptive ribeye contour forming an eroded/di-
lated second adaptive contour where dilation steps are
more than erosion steps;

computer readable code functions operable to cause the
computer to effect determination of a third adaptive gra-
dient between Lean within the eroded/dilated second
adaptive contour and non-Lean going outward from the
center of gravity determining a third adaptive ribeye
contour;

computer readable code functions operable to cause the
computer to effect elimination of corners having a bend

smaller than 90°defining a final ribeye contour;

computer readable code functions operable to cause the computer to effect calculation of total area, Lean area, Fat area, Unknown area, marbling parameters, color measurements of pixels; and

computer readable code functions operable to cause the computer to effect calculate area of a fat strip, average fat strip thickness of a fat strip orthogonal to the final contour.

[c10] An animal carcass grading method for predicting quality and yield comprising the steps of:

inputting an image from an image capturing system;

first adaptively color classifying the darkest and the brightest areas of the image and an area therebetween to define Background, Fat and Lean start points and classifying pixels as Background, Fat and Lean, respectively;

determining an actual Lean color by defining a subarea about a center of gravity of a determined outside contour within image and determining the average Lean color from among the areas classified as Lean inside the subarea and defining the actual Lean color and establishing an adaptive Lean start point; and

second adaptively color classifying areas as background, fat and Lean based on the actual Lean color.

[c11]   An animal carcass grading system as recited in claim 10, where the step of inputting an image from an image capturing system comprises the steps of:

providing an image capturing camera assembly further comprising the steps of,

enclosing a camera in a substantially wedged-shaped housing where said housing has a flat bottom, where said bottom has a viewing window and where the field of view of said camera is canted downward to at least sub-tend the viewing window;

placing the viewing window over an object to be cap-tured;

flashing with a camera flash and capturing an image of the object with the camera; and

outputting the image through a camera image output operable to output an image to an image analysis com-puting system operable to grade the image.